

TRACING THE CRANIAL NERVE PATHWAYS NV AND NVII WITH 3D T2-FFE.

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Introduction

In cancer in the head and neck region, the facial (nVII) and trigeminal (nV) nerves can be affected by microscopic or macroscopic perineural growth. Currently, the majority of head and neck cancers is treated conservatively by (chemo)radiotherapy. In case of perineural growth, the target volume includes the involved cranial nerve. Therefore, correct localisation of the tumor is crucial. So far, localization of the nerves has been largely based on anatomical knowledge, although individual anatomical variations and the disruption of the normal anatomy after surgery lead to compromised accuracy. Localization by MR imaging may greatly improve this accuracy. Several techniques have been used for cranial nerve imaging such as 3D CISS, that gives a negative contrast between the nerves and cerebrospinal fluid. Furthermore, 3D T2-TSE that suffers from long acquisition times due to high SAR and time-consuming fat suppression and 3D DW reversed PSIF [1-3]. To distinguish nerves from the surrounding tissues, suppression of fat, blood and muscle tissue is required. Additionally, to follow the nerves in the head and neck region, high resolution 3D images with a high signal to noise ratio is necessary. We applied a 3D T2-FFE with binomial RF pulses for water-selective excitation. The contrast in this sequence is enhanced by the intrinsic diffusion weighting caused by imaging gradients particularly by the read-out gradient. The aim of this study is to trace the facial (nVII) and the trigeminal nerve (nV) pathways in the head and neck region acquired with a T2-FFE.

Methods

Imaging was performed on a 3T Philips Achieva TX 3T spectrometer (Philips, Best, Netherlands) in 6 volunteers (2 male, 4 female). A 16 channel SENSE NeuroVascular coil was used to acquire images of the head and neck region with a FOV of 23x23x12 cm³ with a voxel size of 0.5x0.5x1.0 mm³. The total acquisition time was 9:50 min. The flip angle was 26°, TR/TE=8.7/3.0 ms, partial echo with a ProSet (121) selective water excitation. One patient with a adenoid cystic carcinoma of the lacrimal gland with perineural invasion underwent a T2-FFE. This patient was imaged in a radiotherapy immobilisation mask to facilitate registration of the images for radiotherapy treatment planning. Therefore, FLEX-M surface coils had to be employed. To decrease measuring time, the resolution was decreased to 0.7x0.7x1.0 mm³. The total acquisition time was 6:20 min.

Results

In all volunteers, nV and nVII were clearly visible and their pathways could be traced from the origin into the peripheral tissues (fig 1). In the fundus of the internal acoustic meatus, the internal auditory canal (IAC), four different nerves could be distinguished (Figure 2). To show the pathways of the nerves, maximum intensity projections (MIP) in 3 directions were performed. Even in the patient who was scanned with a suboptimal sequence while wearing an immobilization mask, the facial nerve was visible (fig 3). Besides nVII and nV, other cranial nerves were identified.

Discussion

We demonstrated that the application of ProSet T2-FFE provided 3D high resolution images with excellent background suppression in volunteers. In a clinical setting, an acquisition time of almost 10 minutes might be too long for a single scan, since a protocol will also include other sequences. Parallel imaging may be used to reduce the scan time at the cost of SNR.

Conclusion

High resolution T2-FFE images with an excellent quality were acquired that allow to trace the cranial nerve pathways of nV and nVII in the head and neck region. This will facilitate and improve the target definition for radiotherapy of patients with microscopic and macroscopic perineural growth and, thereby, reduce the dose to normal tissues. T2-FFE offers great potential for cranial nerve MR imaging.

References

[1] Moon AJNR 2009 [2] Ciftci, Eur J Rad 2004 [3] Naganawa, Mag Reson Med Sci 2010.

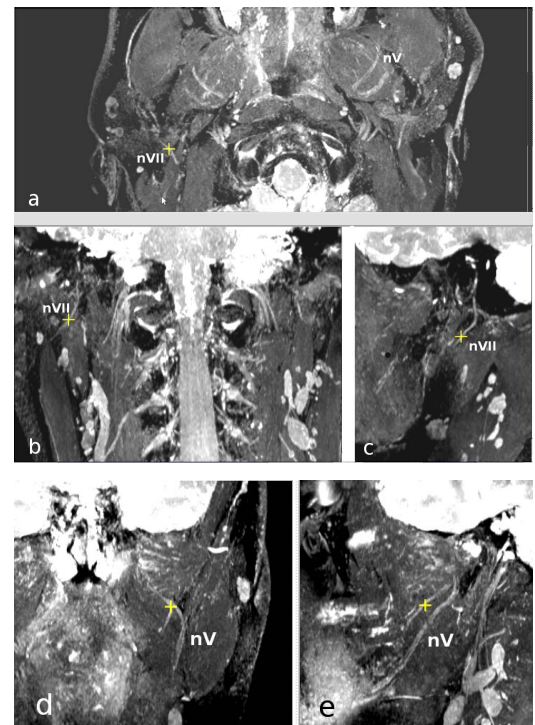


Figure 1. MIPs of T2-FFE images with ProSet for selective water excitation for cranial nerve imaging in the head and neck region. The cranial nerves are clearly visible and can be followed in all directions (transverse a; coronal b, d; sagittal c, e). NV: trigeminal nerve; nVII: facial nerve.

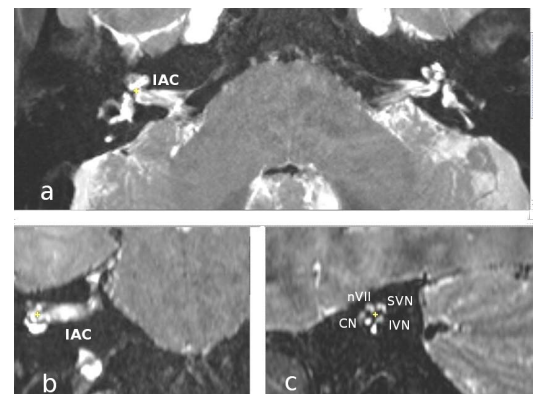


Figure 2. Internal auditory canal (IAC) in a transverse (a) and coronal MIP (b), with the fundus in sagittal MIP (c). The facial nerve (nVII), the inferior and superior vestibular nerve (IVN and SVN, respectively) and the cochlear nerve (CN) can be distinguished.

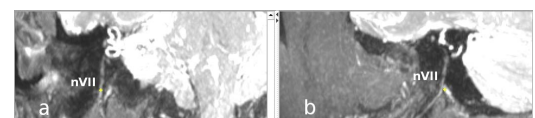


Figure 3. MIPs of facial nerve in a patient in a coronal (a) and sagittal (b) view. nVII: facial nerve.